# OPTICAL LENS FOR DIFFERENTIAL CORRECTION

The invention concerns a new optical correction lens. This lens can be of the necessary dimensions and form to be applied to the cornea of the eye as a contact lens (soft or hard lens); it can also be adapted to be mounted in a spectacle frame.

It is known that after a certain age, the accomodation faculties of the eye weaken and then presbyopia occurs, which can be corrected by bifocal lenses and sometimes trifocal lenses, adapted to the sight of each individual (neutral glass with convergent lens at the bottom for presbyopes with normal distance vision and with superposed portions with different powers for the myopes). These power differences are obtained either by variation of the optical index of the lens (different index range fused into the lens) or by variations of the curvature (which can be progressive).

For distance vision, the eye looks through the central part of the lens, while near vision is obtained by rotation of the eye to look through the bottom part of the lens. Therefore, it is necessary that the eye pivot in relation to the lens in order to permit both distance and near vision. FIG. **1***a* illustrates this phenomenon with a diagram of an eye seeing distant vision through a traditional bifocal lens and FIG. **1***b* shows this same eye seeing near vision.

This type of lens has the inconvenience that the patient, in order to see near, must turn the eyes downward in their orbit into an unnatural position (FIG. **1***b*). The natural gesture is to lower the head so that each eye looks at the objects straight on in natural position in its orbit, but in this case, as shown in FIG. **1***c*, the bifocal lens, which has pivoted with the head at the same time as the eye, cannot play its proper role for near vision.

Additionally, the range of use of bifocal lenses is limited. In fact, the different correction of near and distant vision is possible only if the eye can pivot in relation to the correction lens. That is the case for spectacle lenses or for hard contact lenses which rest in contact against the eyelids. On the contrary, this is not the case for soft contact lenses of which the edges pass beneath the eyelids without engaging on the eyelids and which adhere to the cornea. This perfect liaison between the eye and the soft lens, without great relative movement constitutes one of the essential advantages of the soft lenses which permits them to be tolerated by most patients.

Use of these soft lenses is thus restricted at this time to the correction of one single fault requiring one single predetermined value of optical powers. It is not possible to benefit from these lenses when the correction in vision is differential and requires different near and distant vision powers.

The present invention remedies the aforementioned inconveniences.

One object of the invention is to furnish an optical lens which will permit a differential vision correction of near and distant vision, without notable movement of the eye in relation to the lens, with the eye remaining in a natural position in its orbit.

Another object of the invention is to furnish a soft lens which benefits from the advantages of this type of lens and is also adapted to effect differential corrections.

Before defining the component means of the invention, the existence of a French Pat. No. 1,279,252 is noted, as it describes lenses of which certain provisions are analogous to those of the invention, including the presence in the lens of an inside cavity containing a liquid. At any rate, this provision as described in this patent allows simply for lenses having zones of different value optical power. These means are totally incapable of satisfying the aforementioned objectives, and besides, to obtain differential corrections, the eye must look through different areas of the lens, as illustrated in FIGS. **1***a* and **1***b*, and therefore must pivot in relation to said lens, as is the case for traditional hard lenses.

The optical lens disclosed by the present invention comprises two transparent walls defining an internal space between them, and at least one transparent liquid of predetermined optical index enclosed in this space in such a manner as to occupy it in part; according to the invention, the two walls have a form which is adapted to limit an internal space having a very reduced capillary volume extending over a useful vision area $Z_o$ (surrounding the optical center of the lens), and the quantity of liquid contained in the internal space is such that said liquid is entirely situated in the bottom part of the lens outside of the capillary volume when the lens is in vertical or nearly vertical position (horizontal or near horizontal optical axis), and that said liquid fills the capillary volume by the effect of the capillary forces when the lens is tilted in relation to the vertical to a tilt which is at least equal to a predetermined minimum angle ($\alpha$) (optical axis tilted relative to the horizontal by an angle at least equal to $\alpha$).

The liquid can thus be displaced by the effect of the capillary forces when the lens is tilted: by a simple movement of the head which tilts the lens. The capillary volume which surrounds the useful vision zone $Z_o$ is filled with liquid althrough it carried none initially. The light rays passing through this zone $Z_o$ are subjected initially only to the optical effect of the walls. After tilting of the head and without any notable movement of the eye in relation to the lens, these rays are subjected to the optical effect of the liquid which has come into position of their passageway.

In the case of a lens intended for an eye necessitating an optical power $P_1$ for near vision, the curvature of the walls on zone $Z_o$ and the optical index of the liquid are selected so that the lens has a power $P_1$ suitable for distance vision in the absence of liquid in the capillary volume, and a power $P_2$ suitable for near vision in the presence of said liquid in said capillary volume. The patient always looks through the useful vision zone $Z_o$ of the lens without rotation of the eye in relation to the lens. When the patient looks into the distance, with the head nearly erect, the lens is vertical or near vertical and the capillary space is devoid of liquid so that the light rays passing through zone $Z_o$ are subjected to the power $P_1$ which is suitable for distant vision. On the contrary, for near vision, the head of the patient is tilted and the liquid fills the capillary space and confers to zone $Z_o$ a power of $P_2$, greater than $P_1$, suitable for near vision.

The transparent walls of the lens can be realized of a flexible synthetic material and the lens is then adapted to be applied on the cornea of the eye as soft contact lens. The near vision is obtained, in the absence of any relative movement of the lens in relation to the eye, by the simple natural movement of tilting the head.

The walls of the lens can also be realized of a rigid transparent material such as glass or rigid synthetic material; the lens is then adapted either to be applied on